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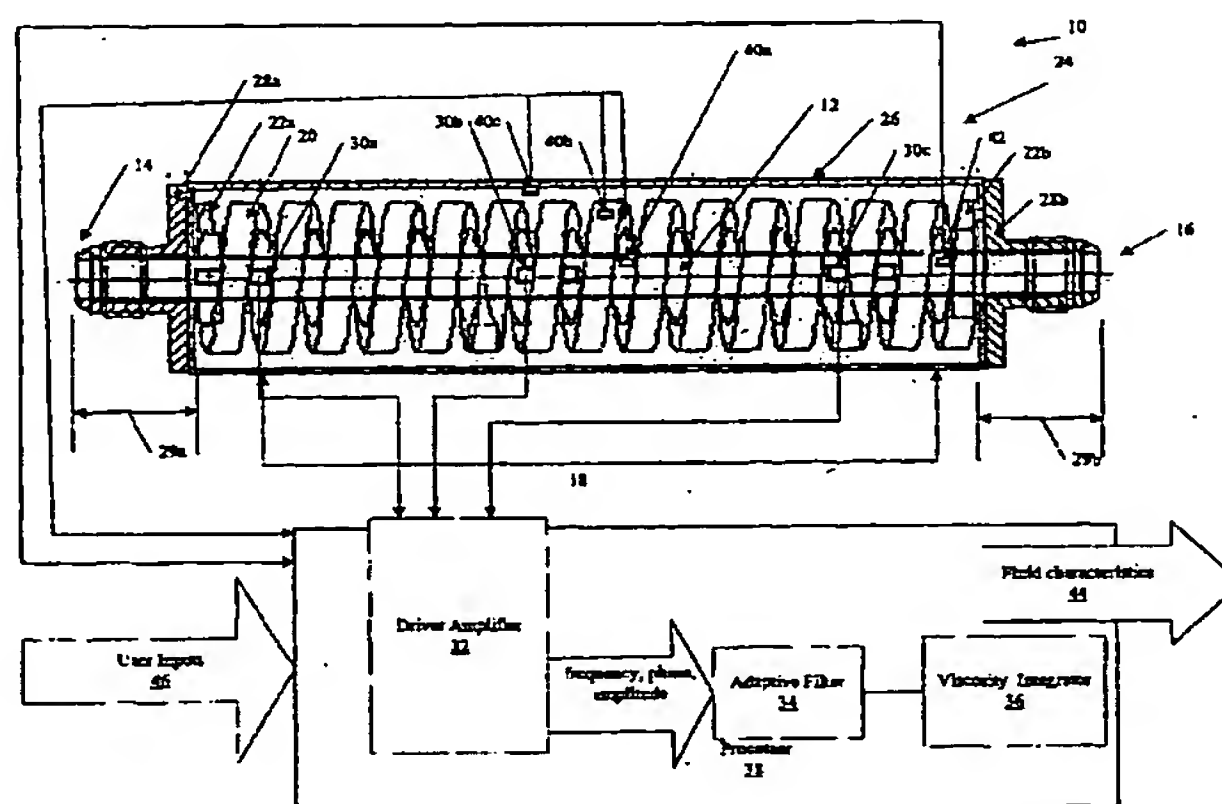
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(54) Title: VIBRATING TUBE MASS FLOW METER



(57) Abstract: A vibrating tube meter measures the density, mass flow rate or viscosity of a fluid material including a vibration section. An exciter induces vibrations in the tube vibration section at a resonance frequency. A motion sensor detects motion of the tube from the induced vibrations. A helical coil spring has opposing ends coupled to the tube with the tube positioned within the interior of the coil spring. An external housing is rigidly coupled to the tube inlet end and outlet end and has a mass selected to provide a suitable nodal mass for the tube vibration section and spring element. Temperature sensors are coupled to the tube, the spring element and the external housing. A pressure sensor is coupled to the tube. A processor includes a drive amplifier and a novel adaptive filter and processes signals from the sensors. A novel viscosity integrator processes signals from the motion sensors, temperature sensors and the pressure sensor to accurately calculate density, mass flow rate and viscosity of the fluid material as well as percent concentration of a solute in the fluid material.



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